Message

From: Davis, Eva [Davis.Eva@epa.gov]
Sent: 3/6/2015 4:30:36 PM
To: d'Almeida, Carolyn K. [dAlmeida.Carolyn@epa.gov]; Wayne Miller [Miller.Wayne@azdeq.gov]
CC: steve [steve@uxopro.com]
Subject: RE: 2015-3-4 - wafb - LNAPL SEE Mobe - ST012

1) Obviously LNAPL does not have to be heated to migrate – it has been migrating into wells for years, where it is recovered and then more migrates in. Pumping can increase migration of NAPL, effectively dragging it into extraction wells – that is the basis for the hydraulic displacement means of recovering NAPL.
2) You receive all the groundwater monitoring reports, as EPA does, and you can confirm that indeed LNAPL has been in W37 since before steam injection was initiated (at least since 2012). If the purpose of a remediation is to recover mobile NAPL, then hydraulic displacement is an option, but it generally requires very closely spaced extraction wells (~ 20 ft spacing). For this site, that is a very large number of very deep wells, making the process cost prohibitive, likely even for the area east of Sossaman. Why mess with steam injection? Because not all of the mobile LNAPL can be induced to flow into the wells just by pumping, and residual LNAPL would remain in the pore spaces of the soil, which would continue to contaminate the groundwater for many years to come. By using steam injection, residual NAPL behind the displacement front is volatilized and recovered, removing the source to groundwater, and allowing restoration of the groundwater.
3) The weekly progress reports (which ADEQ has access to off the AMEC website) shows perimeter groundwater elevation changes in Table 2 (page 22 of the March 4 report). It shows that W37 is drawn down by 2.53 feet from the baseline on 2/27, which was the last of the weekly measurements. All of the W wells (lower semi-confined zone wells) were drawn down from baseline on 2/27, but 2.5 to 4.18 feet.
4) The well screen for W37 is submerged – according to the groundwater monitoring report, the well screen is from 245 to 210 ft bgs, while the water level in this well is approximately, on average, 150 ft bgs (according to Figure 22 of the weekly progress report). The movement of the groundwater in this zone can drag trapped (trapped below the low permeability zone) mobile LNAPL into W37, where in the well itself it will rise to the water table, but the LNAPL is not floating to the water table in the formation and then into the well.
5) Good question – that is something we will need to determine by additional characterization after the thermal, and before the enhanced bio is initiated. I don't buy the monster bit either.
6) Pumping the lower portion of the aquifer could have dragged trapped LNAPL into the well. This is the best explanation I have now. Please note that 70 feet inside the 4 inch casing amounts to about 45 gallons of LNAPL. This does not necessarily indicate that there is a huge amount of LNAPL across Sossaman, although that remains to be determined. The March 4 progress report shows that the 70 feet of LNAPL have been recovered (if you remember on the last conference call AMEC said they did not recover it initially because bailing it was ineffective, but they then permanently installed a pump in this well and are recovering LNAPL when it accumulates), and the LNAPL accumulation on 2/27 was 4.09 feet.

From: d'Almeida, Carolyn K.
Sent: Wednesday, March 04, 2015 4:50 PM
To: Wayne Miller

Cc: steve; Davis, Eva
Subject: RE: 2015-3-4 - wafb - LNAPL SEE Mobe - ST012

Wayne

For number 1 I think the assumption would be correct if we were doing ERH. But steam removes primarily by displacement, and volatilization (via temperature) is secondary, especially with an inside out operational approach where its difficult to get temperatures high enough to volatilize. At Bill Mabey's Alameda project most of the mass was removed in vapor phase because the central extraction well was surrounded by injection wells that fully surrounded the small source area and heating was more uniform, whereas in the TEE pilot the central injection well surrounded by extraction wells were drawing cold water from outside the cell along with the hot from inside the cell. After TEE we did see higher NAPL concentrations outside the TEE cell but hard to interpret if that was due to the pump failures in the extraction wells or due to water table rise into the cobble zone allowing spread of mass or water table rise into vadose zone submerging more NAPL. I think we will have the same situation here as well, difficult to interpret results due to many possible explanations. But as long as they can maintain containment as demonstrated by water levels and temperatures I'd say its being contained. The fact that a slug of NAPL is flowing into well 37 as a result of steam operations doesn't worry me as long as they are removing it! They should keep producing that well as long as it is productive as a form of thermally enhanced pump and treat (TEP&T).

From: Wayne Miller [mailto:Miller.Wayne@azdeq.gov]
Sent: Wednesday, March 04, 2015 1:21 PM
To: d'Almeida, Carolyn K.
Cc: steve
Subject: 2015-3-4 - wafb - LNAPL SEE Mobe - ST012

You are very correct. Which is why there is a conundrum. Management has creative thoughts for every ST012 fact and unknown.

(1) LNAPL would have to be heated, which would require hot water to pass by trapped petroleum first. Terra Therm insists NO HEAT AT W37. AMEC INSISTS NO HEAT AT W37. Can't mobilize if no heat moving the LNAPL. Even given decreased petroleum viscosity due to heat, the petroleum would have to flow faster than water, and only immediately cool just before reaching W37 so as not to heat up the W37 area.
(2) If just natural migration, and AMEC is right that there has always been LNAPL in W37, and W37 and all well points are preferred pathways, then why mess with TEE and SEE? Just pump W37 and install other wells east of Sossaman and pump.
(3) As Eva pointed out, W37 is below semi-permeable layer. Why has AMEC/terra therm not provided potentiometric surface maps for each of the 3 layers? Is lower zone semi-contained aquifer actually drawn down? Even as far away as W37?
(4) Assuming that LNAPL is condensing/accreting/mobilizing from low permeability matrix and rising to "aquifer surface", the accumulation in W37 would indicate an "upslope swimming movement". If LNAPL can "swim/float/rise" upslope in "de-watered" strata, then how can LNAPL be contained?
(5) If LNAPL is being pulled back toward the SEE extraction pumps, then where is the downstream leading edge east of Well 37? Management does not buy into the LNAPL as a horror movie monster trying to climb out of the one and only access hole to the surface. The plume is likely much broader and longer than what is captured by in maybe a 16 inch diameter disturbed-soil borehole and one permeable, vertical center column (W37).
(6) W37 skyrocketed from a few feet to 70 feet. Again ADEQ management wants to know why. What changed? Don Atkinson indicated that he thought, but wasn't sure, the ST012 central area wells only recorded about 35 feet LNAPL at the release area and the TEE area.

Questions come from managers. Most know petroleum UST releases. But they answer to leadership, which are lawyers. Therefore they have to have an answer for every creative thought which may pop into leadership.

From: d'Almeida, Carolyn K. [mailto:dAlmeida.Carolyn@epa.gov]
Sent: Wednesday, March 04, 2015 11:57 AM
To: Wayne Miller; Davis, Eva
Cc: steve
Subject: 2015-3-4 - wafb - LNAPL containment ST012 - mobile napl cda epa mo

Sorry, I was out of the office yesterday and catching up. My understanding of behavior of NAPL in the subsurface is that NAPL thickness in a well is more of an indication of NAPL mobility than quantity. Steam is going to mobilize NAPL – that's the whole point of why we are doing it, to mobilize the NAPL to where it can be recovered. Mobilized NAPL will migrate to places where it can pool and will accumulate in to well casings as it is forced out of the formation. Doesn't necessarily mean that it is migrating past the well casing and back into the formation.

From: Wayne Miller [mailto:Miller.Wayne@azdeq.gov]
Sent: Tuesday, March 03, 2015 10:27 AM
To: Davis, Eva
Cc: d'Almeida, Carolyn K.; steve
Subject: 2015-3-3 - wafb - thanks - LNAPL containment ST012 -

Thank you. ADEQ management issue is not strictly SEE-related (temperature). Management sees LNAPL in W37. Even if drawdown pulling LNAPL back to W37, management countered that plume had to be beyond W37 in order to be pulled back to W37. Management sees CERCLA purpose to be protective and restore. W37 only one point along plume, and not necessarily the downgradient limit point. If product is beyond SEE bounds and has dispersed away from active remediation site (assume while containment pumping turned off during SEE build), then ST012 remedy not protective and not restorative (of full release).

From: Davis, Eva [mailto:Davis.Eva@epa.gov]
Sent: Tuesday, March 03, 2015 9:45 AM
To: d'Almeida, Carolyn K.; Wayne Miller; steve@uxopro.com
Subject: 2015-3-3 - wafb - LNAPL containment ST012 - edavis epa -

Wayne –

Since Amec is taking their time responding, and management may be breathing down your neck, let me give you some quick replies to some of your questions –

LNAPL crossed Sossaman Road long before the full scale steam injection was initiated. In fact, I seem to recall that you guys noticed the LNAPL accumulation in W37 reported in the groundwater monitoring report for ST-12 even before I did. The final 2013 groundwater monitoring report shows that 5 gallons of LNAPL were recovered from W37 in 2013 (see table on page 3-11). That was the most LNAPL recovered from any ST-12 well in 2013. The lower table on that page shows no LNAPL recovered from W37 in 2012, the text on page 3-2 states that there was LNAPL in W37 in 2012 but insufficient quantity to recover it. Because this well has a submerged screen, and there is a semi-confining layer above it that (according to the site CSM) traps LNAPL at depth, a lot of the rules for LNAPL accumulation in wells doesn't apply here. I don't think we can tell anything about LNAPL being moved to this area by the fact that there is now a greater accumulation there – it very well might be that the groundwater extraction reduced the water level enough that more of the LNAPL was able to enter the well. It is very difficult to say. I believe W37 is a 4 inch diameter well, which means that that 70 feet of accumulation amounts to about 45 gallons, if my calculations are correct. Not much compared to how much is out there and how much has already been recovered. By continuing to extract more groundwater than is

injected, LNAPL should not be pushed further away by the steam injection. The pressure cycling they will be doing later, where injection is scaled way back and extraction continues, will do more to pull some of that contamination back.

I've attached the steam injection issue paper that I wrote some years ago – it's outdated, but I believe there are a couple of points in there that are relevant to these concerns. One, is that temperature is a very good tracer. It was found at oil recovery operations using steam injection that temperature increases could be detected before any of the oil reached that monitoring or extraction point. So the fact that no temperature increase has been detected at W37 means the well is not being directly affected by the steam injection.

The second point is that the steam injection cannot really become 'uncontrolled'. There is a maximum size of the steam zone that can be created at a certain steam injection rate, due to the heat losses to the overburden and underburden. The steam zone cannot continue to grow uncontrolled in any direction.

Hope this helps until the response from AMEC is received -

Eva

From: d'Almeida, Carolyn K.
Sent: Thursday, February 26, 2015 4:21 PM
To: Davis, Eva
Subject: FW: 2015-2-24 - wafb - LNAPL containment concern - ST012

From: Wayne Miller [mailto:Miller.Wayne@azdeq.gov]
Sent: Tuesday, February 24, 2015 3:28 PM
To: catherine.jerrard@us.af.mil
Cc: d'Almeida, Carolyn K.; steve
Subject: 2015-2-24 - wafb - LNAPL containment concern - ST012

Just wanted to make you aware of some ADEQ management concerns.

ADEQ Unit Management is disheartened to hear LNAPL reported east of Sossaman Road (well 37) via multiple monitoring periods. Management not convinced contaminant contained. Management questions whether sentinel wells exist to show LNAPL extent.

Management has directed staff to emphasize lack of confidence in ST012 containment.

Specific management questions:

(1) How (what trigger event) occurred to allow LNAPL to migrate east of Sossaman Road?

(2) When did the LNAPL cross Sossaman Road?

(3) What time interval accounts for LNAPL migration

(4) Is LNAPL migration ongoing?

(5) Will LNAPL impact area further east?

(6) Will LNAPL quantity increase as a result of SEE operations?

Management also ended with this quip:

(7) Responsible party to provide proof/defensible data to show issue understanding and handling.

Wayne Miller,
ADEQ, Federal Projects Unit
e-mail: miller.wayne@azdeq.gov
phone: 602.771.4121

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